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ABSTRACT

Economists are aware of the importance of human capital in the process of development, whereas policy makers are only now exploring its implications, pressed by demands for more jobs and higher incomes. Recent research in the dynamics of labor markets illustrates how the results can help shape education and training policy in the United States. For nearly 2 decades, the body of research stressing the importance of human capital on growth and development has grown. Economic policy debates focus on investing human capital both as a way to encourage overall economic growth and as a way to expand opportunities for the economically disadvantaged. Studies have focused on how training acquired from employers affects the work experience of employees and other work history factors as well. Although this body of research necessarily identifies general relationships, its findings help policy makers wrestling with three policy questions: What are the effects of employer-sponsored training? Do employers invest enough in employee training? and How will the accelerating pace of technological change affect the need for employer-sponsored training and for complementary investments in education? (An appendix lists data sources. A list of 32 references is provided.) (NLA)

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EDUCATION, TRAINING AND LABOR MARKETS: SUMMARY AND POLICY IMPLICATIONS OF RECENT RESEARCH BY JACOB MINCER

Roger J. Vaughan
Roger Vaughan Associates

Conference Paper No. 13

December 1989

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PREFACE

The National Center on Education and Employment is funded by the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education. The Center is based at Teachers College, Columbia University, in New York City. The RAND Corporation of Santa Monica, California, and Washington, D.C., is a partner with Teachers College in this enterprise.

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FOREWORD

Jacob Mincer's seminal research offers fundamental answers to profound questions that policymakers have been asking. This paper is an attempt to mine that research, elucidate the policy implications, and link them to the issues driving the national debate about education, training, and labor markets.

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SUMMARY

Success in the labor market is the outcome of a complicated and poorly understood interaction among ability, skill development in school, formal and informal training on the job, and adaptation to changing conditions through job mobility and retraining.
Jacob Mincer, 1986

Both the causes and consequences of economic development are prime concerns to state and federal policymakers. When the economy falters and unemployment rates rise, the public expects state or federal government to repair the damage. Even when the economy is healthy, policymakers are subject to demands to help the inevitable victims of economic change—those whose employers have shut down, whose skills have been rendered obsolete, and those who are unable to enter the economic mainstream. Investments in human capital are vital to helping these people.

Although economists have been aware of the importance of human capital in the process of development, policymakers are only now exploring its implications, pressed by demands for more jobs and higher incomes. This paper reviews recent research in the dynamics of labor markets reported in six papers by Jacob Mincer and describes how the results can help shaping education and training policy in the U.S. These papers are: 1) Jacob Mincer and Yoshio Higuchi, "Wage Structure and Labor Turnover in the United States and Japan," *Journal of the Japanese and International Economies*, Vol.2, 1988, pp.97-133; 2) Jacob Mincer, *Education and Unemployment*, Report Submitted to National Center on Education and Employment, Teachers College, Columbia University, May 1988a; 3) Jacob Mincer, *Job Training, Wage Growth, and Labor Turnover*, Columbia University, 1988b; 4) Jacob Mincer, *Labor Market Effects of Human Capital and of Its Adjustment to Technological Change*, Paper prepared for Conference on Employer-Sponsored Training, Alexandria, VA, 1988c; 5) "Education and Unemployment of Women," National Center on Education and Employment, April 1989a; and 6) "Human Capital and the Labor Market: A Review of Current Research," *Educational Researcher*, May 1989b, pp. 27-34.

For nearly two decades, the body of research stressing the importance of human capital on growth and development has grown. The publication of *Nation at Risk*, more than any other single document, elevated the importance of human capital in policymakers' eyes. Throughout the 1980s, economic policy debates have come to focus on investing in human capital, both as a way to encourage overall economic growth and as the way to expand opportunities for the economically disadvantaged. Human capital investments today exceed net annual investments in plant and

equipment. Brookings Institute economist Edward Denison estimates that improved skills and increased knowledge account for two-thirds of the annual growth in per capita income.

These studies have examined the labor market history of thousands of people, collected over time through many different surveys of employees. Much of the research focuses on how training acquired from employers affects the work experience of employees, but addresses other factors that influence work history as well. Although this body of research necessarily identifies general relationships, its findings can help policymakers wrestling with three policy questions.

1. What are the effects of employer-sponsored training?
2. Do employers invest enough in employee training?
3. How will the accelerating pace of technological change affect the need for employer-sponsored training and for complementary investments in education?

1. What Are the Effects of Employer-Sponsored Training?

Why is this question important? Public policies, from tax codes to direct training programs, influence the level and the effects of employer-sponsored training. Policymakers need to know whether these policies are reducing or enhancing employer investments and whether, and in what way, those policies should be changed.

Policymakers are concerned that employers are serving only a small part of the workforce, or are systematically overlooking certain types of employees. In the past, government programs have offered special training for low-income people, displaced workers, and others in order to place them in private jobs. When policymakers know who is not served, they can direct public investments more effectively to fill gaps.

What do we know? Trained employees are more productive and are less likely to change jobs. If they do quit or lose their jobs, they experience shorter periods of unemployment. Employer training accounts for an estimated six out of every seven dollars in earnings gained over a working career; changing employers accounts for only one dollar out of seven.

Human capital, accumulated through employer-training, however, appears to depreciate quite fast: on average, three-quarters of the present value of the benefits are enjoyed during the first five years. Employers, therefore, can recapture much of the benefits of their investments in their workforces.

But employers do not train everyone. Those who failed to acquire basic skills in school are much less likely to receive training from their employers than those with better qualifications.

What does this imply for public policy? The ability of trained employees to move to employers making the best offers may not, as some people have feared, deter employers from training their employees. It also may not justify—at least on efficiency grounds—subsidizing employer training more deeply.

Second, these research studies have measured the costs and benefits of employer-sponsored training by their effects on earnings, unemployment, and job turnover. A similar approach could be used by policymakers and public administrators to monitor the effects of public education and training programs.

Third, the economic prospects of people without sound basic skills will not be advanced simply by placing them in private jobs. Few employers will remedy basic skill deficiencies among their workers. Unless they enter the workforce with better skills, they will fall further behind their better-qualified fellow workers.

2. Do Employers Invest Enough in Employee Training?

Why is this question important? Falling test scores, slow productivity growth, mounting trade deficits, and the failure of many disadvantaged people to participate in the economic expansion during the 1980s has led policymakers to suspect that the nation may be underinvesting in the skills of its workforce. Because employer investments in employee training are such a large part of the total national investments in human capital, employers may be a major cause of systematic underinvestment.

What do we know? The best way to assess the adequacy of overall levels of employer investments is to compare the rate of return on training investments with the rates on other types of investment—plant and equipment, formal education, or research and development, for example. The rate of return expresses the higher wages and long-term productivity that result from training as an annual return on the costs—the reduced productivity of employees during training and the direct expenses of the training programs.

Unfortunately, estimates of both the costs and the benefits vary so widely that we cannot select a "most likely" range. Therefore, we cannot conclude that the rate of return to employee training is high enough to prove that employers systematically underinvest in human capital, or low enough to indicate that they systematically overinvest. Even if the range of estimates were more narrow, it would be dangerous to interpret the rate of return as an unambiguous indicator of under- or over-investment because we have no measures of the risks associated with training investments relative to the risks of other investments and we have not yet developed accurate measures of the costs of the time and effort invested by both employers and employees.

What does this imply for public policy? Since we cannot select the most likely range for the rate of return, there is no empirical evidence to support either increases or reductions in incentives for employer-sponsored training.

If policymakers decide to provide further incentives for employer investments, they should examine the incentives to both employers and employees. Investments in employee training are determined by incentives offered to employers (tax credits and direct cost subsidies), as well as by policies that shape employee behavior such as the personal income tax rates, payroll taxes, the minimum wage, and access to education and training not offered through work.

In view of the importance of human capital investments to overall economic growth, data should be collected systematically to allow the analysis of the level and effectiveness of all types of human capital investments. The data should be at least comparable in detail with data on investments in plant and equipment reported by the U.S. Department of Commerce.

3. How Will the Accelerating Pace of Technological Change Affect The Need for Employer-Sponsored Training and for Complementary Investments in Education?

Why is this question important? The capacity and structure of public training and education programs cannot change quickly. The federal role is limited. But state and local agencies finance and manage a large share of education and training programs, including programs used by local employers. State and local actions depend upon perceptions of skills problems, the success of existing programs, and local fiscal conditions. Anticipating how skill demands will change, therefore, may give public administrators some lead time in adapting the system to meet them.

In addition, successful human capital investments depend on coordination among employers and educational institutions. Understanding the changing demands for human capital makes these links more effective.

What do we know? New technologies demand better-educated employees and pay them higher wages than industries where technology not changing as rapidly. Although new technologies displace people from jobs and change the nature of work, industries where technology is changing rapidly experience below average rates of unemployment.

What does this imply for public policy? Employers' demands for better-educated employees will grow as the speed with which new technologies are introduced grows. Without a supply of such workers, employers' ability to employ new technologies may be slowed, slowing down the rate of growth of productivity and real income.

But the accelerating demand for better educated employees may create a dual labor market, in which the earnings of the well-educated grow rapidly while the earnings of the less-educated fall. Public programs must prepare a much larger share of the new entrants for well-paid skilled jobs.

QUESTION 1: WHAT ARE THE EFFECTS OF INVESTMENTS IN EMPLOYEE TRAINING?

People who have greater learning ability and better opportunities to finance the costs of human capital investments invest more in all forms of human capital, including schooling and job training. Some analysts claim, in addition, that school education is a complementary factor to job training. It is clear, however, that schooling can also be a substitute for job training.

Jacob Mincer, 1988

THE POLICY ISSUE

Do employers make good trainers and do employees make rational career decisions about training on the job? Can we learn anything from research on employer-sponsored training about the effectiveness of employer-sponsored training that may help those managing public education and training programs?

Do employers serve only a small part of the workforce, and overlook the potential benefits of training certain types of employees? Government programs encourage employers to hire disadvantaged people, who are perceived as being ignored by employers. Special training programs for low-income people, displaced workers, and others have invested heavily in placing disadvantaged people in private employment. Are these programs compatible with what we know about employer hiring and training behavior?

Public sector spending accounts for much larger direct shares of human capital investments than it does of physical capital investments:

> In 1985, $143 billion out of $157 billion for primary and secondary education; $49 billion out of $65 billion for higher education; and $23 billion for direct government training—a total of $215 billion.[1]

By contrast, gross public investment in physical capital was only $50 billion.[2] The importance of public investments may be greater than their share of investment spending: formal education—which is largely public—is a prerequisite to employer human capital investments. Over one-half of the nation's investments in human capital, therefore, and a large part of the nation's

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[1] These estimates are from the Office of Technology Assessment, 1988, Table 3-26.

[2] This includes total public spending on infrastructure together with Department of Defense expenditures on plant and equipment for defense contractors.

annual increases in productive capacity, are managed by public agencies that determine their investments with little information about the effectiveness and efficiency of their expenditures.

THE EVIDENCE

Employer-sponsored training raises wages, reduces unemployment, and reduces job turnover among those trained. The picture of the labor market painted by recent empirical research is that the market accomplishes the basic task of matching people with complex career opportunities. Both buyers and sellers of human capital services behave in predictable and rational ways: Employees are willing to sacrifice present earnings for the opportunity to acquire skills; Employers, for their part, are willing to invest in those employees who have shown the ability and the willingness to learn.

The wages of people being trained by their employers grow 4 to 6 percent faster (annually) than wages of employees who are not being trained and about 1 percent faster afterward. But skills depreciate.[3] The effect of training on wage growth is greatest for young workers, those who have been working for less than 12 years. A year of training raises wages of young workers by about 9.5 percent compared with only 3.5 percent for workers with more than 12 years experience.[4] The lower increases received by older workers reflect the lower intensity of training among older workers (fewer hours per week) and the fact that older workers have acquired skills on the job, so the training adds less to their productivity.

Even if trained workers change jobs, their wage trajectories are above those of untrained workers, indicating that they have received general marketable skills as well as skills specific to the job. But changing jobs is much less important than training in explaining growth in wages. Improved productivity resulting from training by employers accounts for about 85 percent of the

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[3] These estimates of the wage gains drawn from Panel Study of Income Dynamics (PSID) data are similar to estimates by J. Barron et al., 1989, using Employment Opportunities Pilot Projects (EOPP) data and by Lynch, 1988, using National Longitudinal Surveys (NLS) data, and Lillard and Tan, 1986, using Current Population Survey (CPS) data. All studies find that wages increase sharply during the training period and then moderately afterward. They are also similar to the range of wage gains estimated for an apprenticeship program in 1962—see Mincer, 1962.

[4] These results have been supported by recent work by Brown (1988), who separated the influence of prior skills and job tenure, and found that one year of training raised wages by about 9 percent.

gains in career earnings compared with only 15 percent from moving among employers.[5] The relative importance of training to moving is lower for younger workers but grows with age. Workers who move twice as frequently as the average would actually experience a slower increase in income—40 percent over a 15 year period compared with 46 percent for those who moved an average of 2.25 times.

Training provided by employers imparts skills specific to the job as well as general skills. The increase in earnings after training is equal to about one-half of the increase in productivity.[6] This probably reflects the sharing of training costs between employers (who absorb part of the costs of the lower productivity of trainees) and employees (who may receive lower wages during the earlier stages of training).

Both education and job training reduce the probability of employees either quitting or being laid off from their jobs

Job training further reduces the probability of experiencing unemployment and its average duration, even allowing for the higher levels of education of trained employees. If educated or trained workers are laid off, they are unemployed for a shorter time than those with less human capital since they are better at searching for alternatives and are more intensively sought by employers with vacancies. More than one-half of all job changes occur without unemployment.

Educated and trained workers appear able to search for alternative employment while remaining employed. Since trained workers expect to receive further training at their next job, they anticipate longer tenure, and therefore search more carefully than untrained workers.

Workers trained by their employers are less likely to change jobs than those who have not been trained

Regardless of their mobility before training, employees are less likely to leave their jobs after training from their employer.[7] This effect is stronger for older than for younger workers.

Also, regardless of their initial mobility, employees trained by one employer are more likely to be trained by subsequent employers and to enjoy longer tenure in those subsequent jobs. This

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[5] Mincer 1988c, p.12ff.

[6] Barron, Black, and Loewenstein, 1989, and Blakemore and Hoffman, 1988.

[7] Mincer, 1988c, Table 5A and 5B, and Table 6.

implies that well trained workers are better able to choose suitable jobs and that employers screen applicants for jobs requiring training more carefully than they screen applicants for unskilled jobs.

Women are much less likely to be trained by their employers than men, even allowing for differences in their prior educational attainments. They are more likely to get further education and training on their own than men. Employers are less willing to train women because historically their payoff period is shorter and less certain. For a similar reason, training declines as employees' seniority on the job advances.

Education and skills are important not only for being productive in jobs but for adapting to inevitable disruptions in work experience. Economic development inevitably means the loss of some jobs and the creation of others and the changing of many jobs. Some firms fail to compete, products become obsolete, skills depreciate, some employees find their jobs less rewarding than they had hoped, and employers find some new hires not as fit for their jobs as they had expected.

Because the cost of time and foregone productivity is higher for skilled than for unskilled workers, skilled workers and their employers invest more efficiently in gathering and screening information. Because their opportunity costs are lower and their search skills less developed, unskilled workers take much longer to search for another job. As a result, they suffer higher unemployment rates. As the demand for skilled workers has increased, their unemployment rates have fallen relative to the rates for unskilled workers.

Table 1

Education	Percent Engaged in Training	Their Weekly Hours	
		Separate	Joint with Production
0-8 Grades	39	0.3	2.8
9-11 Grades	56	1.3	6.9
HS Diploma	57	1.6	8.3
HS+NonAcad. Training	61	1.2	8.1
Jr. College	71	3.2	6.5
BA+	58	1.5	5.7

Source: G. Duncan and F. Stafford, "The Use of Time and Technology by Households in the United States," *Research on Labor Economics*, Vol. 3, 1980.

Employers Train Their Most Qualified Employees

Career investments in human capital—either on the job or in educational and training institutions—build upon education acquired prior to entering the labor market. Despite the overall flexibility within the labor market, employees with poor basic skills suffer a large and enduring handicap. Employers invest more heavily in better-educated or better trained employees (Table 1).[8]

Employees receive more training from employers the more educated they are and the greater their work experience. But this may reflect the fact that people of similar abilities invest in both types of human capital—formal education and on-the-job training—rather than that the first leads to the second. Or it may mean that education achievement makes people better able to use employer-provided training productively. At present, we cannot select between these two hypotheses. But the answer to this question is important for public policy. If the two investments are complementary, remedial education would be more helpful to poorly-educated people than simply finding them private sector jobs. Without stronger basic skills, they would not move ahead in their jobs. If, on the other hand, innate ability is the determining factor, remedial education may be able to achieve little.

The effectiveness of employers' investments in training their employees depends heavily on the attainments of those employees before they enter the workforce. But the basic skills acquired during primary and secondary education have been declining, or failing to grow as rapidly as employers' demands are rising.[9] Unless this trend is reversed, employers will face a growing shortage of qualified employees. They will be unable to overcome the shortage through their own investments except at vastly increased costs.

POLICY IMPLICATIONS

1. Economists have warned that employers will be deterred from investing in their employees if those employees are likely to change jobs, carrying their new skills with them. But employers are able to recapture a large part of the increased productivity that training creates because most training embodies both specific and general elements and because the benefits are fairly short-lived. Also, although trained employees can move to the employer making the best offer, trained employees are less likely to move than those who have received less training.

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[8] This conclusion is supported by research with an NLS sample by Lillard and Tan, Op.Cit., and by research by Barron et al. 1986.

[9] Nation at Risk and Bennett, 1988.

2. The way that the value of education and employer-sponsored training is measured through changes in labor market behavior—such as reduced unemployment rates, shorter duration of unemployment, higher wages—could be used to measure the effectiveness and efficiency of public education and training programs.

Investments responsible for a growing share of the nation's annual increase in productive capacity will be managed by federal, state, and local governments. This investment spending is made largely on the basis of allocation formulas, not on effectiveness.[10] Public education expenditures are made without the market signals that guide private capital investments.

Policymakers rarely estimate the value of participation in publicly-sponsored education and training programs in terms of the labor market measures used in these studies of employer-sponsored training. The quality of secondary education, for example, is measured in terms of curriculum covered, class size, teacher qualifications, or performance on standardized tests.[11] None of these measures records the ease with which graduates find work, how much they earn, and the speed with which their careers advance. With the exception of test scores, these measures focus on the *process* of education, not its *outcomes*. Yet measuring outcomes is vital in assessing how the public can invest most effectively.

The need to measure results was clearly stated in the report on education by the nation's 50 governors, *Time for Results*, issued by the National Governors Association in 1986. "The nation and the states and school districts," the report argued, "need better report cards about results, about what students know and can do." Since the report, however, education reforms that raise teachers' pay and increase school funding have been undertaken more readily than reforms that measure performance or that tie public spending to performance.[12]

Some of the steps being taken to improve school performance are now increasing accountability. By their growing financial involvement and leadership, corporations are encouraging state and local governments to pay much closer attention to primary and secondary education. During the 1980s, many states have made education their top policy priority, both as a means to promote economic development and as a means to deal with the problems of the economically

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[10] National Governors' Association, 1986, and Bennett, 1988.

[11] Ibid.

[12] Ibid.

disadvantaged. It is too early to know how good the ensuing wave of reforms will prove,[13] but approaches include parental choice, greater reliance on school-based management, higher teacher qualifications, higher graduation requirements, and performance-based financial incentives.[14]

Policymakers will be able to assess the value of these controversial changes if they begin the process of measuring labor market outcomes, using the techniques that have been demonstrated in recent studies of employer-sponsored training. Labor market outcomes are certainly not the only measure of success. Enrollment in postsecondary programs, reduced drop-out rates, and even indirect behavioral measures such as reduced rates of teenage pregnancy are also important concerns. But almost all high school graduates eventually enter the labor market, and their ability to pursue rewarding careers—ability to control and adapt to changes in skill demands—is an important outcome.

3. Prospects of people without basic skills will not improve if they are simply placed in private sector jobs because training on the job will not remedy their deficiencies. Unless skills are improved before they are hired, poorly educated people will fall further behind their better-qualified fellow workers.

Policymakers should not interpret persistent high unemployment rates among unskilled workers as a symptom of the need to "create" new jobs through public works or public employment programs. Unemployment is more likely to signify inadequate basic skills and the inability to acquire training on the job. Remedial education or further training may deal with the problem more effectively than recruiting industry, financing public works, or cutting taxes.

For three decades, the federal government has sponsored training programs intended to place economically disadvantaged people in unsubsidized, private sector jobs. At present, the Work Incentive Program (WIN) and programs sponsored by the Job Training Partnership Act (JTPA) are intended to reduce people's dependence on public assistance by helping them find jobs rather than helping them gain basic skills or learn an occupation. Past evaluations have found that disadvantaged people enjoy long-term income gains if they receive intensive classroom training but few gains if they are merely placed in jobs.[15]

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[13] U.S. Department of Education, 1986.

[14] These are analyzed by McDonnell, 1989.

[15] Robert Taggart, 1982.

JTPA offers involve relatively superficial assistance (placement rather than skills training) provided to the most qualified among the eligible population.[16] Although the program boasts higher placement rates than did its predecessor, Comprehensive Employment and Training Act (CETA), many, perhaps most, of those placed would have found work without participating in the program.[17] Less than one-third of the clients served received formal education training; the rest were taught how to search for work.

The continued separation of education and economic development policy may become increasingly costly as the effectiveness of public human capital investments becomes more important. Many of the federal and state economic policies intended to deal with the problem of worker displacement—financial support for ailing industries, advanced notification, relocation assistance, or even attempting to recruit replacement firms—fail to address the basic problem: those workers with problems in finding new employment need to extend their education or training.[18]

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[16] Levitan and Gallo, 1988.

[17] Ibid., and Dickinson, 1986.

[18] For a review of programs for displaced workers, see Buss and Vaughan, 1989.

QUESTION 2: DO EMPLOYERS INVEST ENOUGH IN TRAINING THEIR EMPLOYEES?

We are all in the process of buying and selling knowledge from one another, because we are so profoundly ignorant of what it takes to complete the entire process of which we are a small part.

Thomas Sowell, 1982

THE POLICY ISSUE

Many people believe that the United States invests too little in educating and training its people. Tests measuring what school children know record lower scores today than two decades ago; foreign school children prove better on math and science tests than those in the U.S.; and employers complain that the greatest problem they face is finding qualified employees. These problems seem linked to economic and social problems—mounting trade deficits, loss of competitiveness in international markets, and persistent poverty in inner cities and rural areas.

Since employers' investments may comprise about one-third of our annual human capital investments, their actions may be a large part of the problem and a large part of any strategy to improve the skills of the workforce.

THE EVIDENCE

There is little evidence linking our economic problems to a deficiency of employer-sponsored training. The returns on employer investments in training are difficult to measure or to interpret. Data on the costs incurred by employers and employees are not precise, estimates of the gains in productivity from training employees vary widely, and some of the benefits of training may not be reflected in observed labor market behavior.

Measuring and Interpreting the Rate of Return on Employer Training Are Difficult

The best guide to whether employers under- or over-invest in training their employees is the rate of return they enjoy on their training investments relative to the rates of return they could earn on other types of investments. The rate of return measures the relationship between the benefits of training-increased earnings, greater job stability, or more stimulating employment—and the costs—the lower productivity of trainees during training, the extra time and effort invested by trainees, and the direct expenses associated with training at work.

If the rate of return on training is above the rate that can be earned on other assets, then employers may be underinvesting, because resources could be profitably shifted from other types of investments to training employees.

The rate of return, however, is difficult to compute because we cannot quantify all the benefits and costs of training. Many benefits may not be realized until many years after completing training and may not be "priced" in labor market transactions. What value can be placed on a more stable workforce? Trained people may also value the wider choice of careers that follow from acquiring skills.

Estimating many of the costs of training is also difficult. We can measure how much employers and employees spend directly on training but cannot easily measure the indirect costs—the time and effort invested by employees and employers—nor the risks to employers that trainees do not perform as intended nor the risks to employees that jobs are not as attractive as hoped.

Even if costs and benefits could be determined accurately, and a rate of return computed, interpreting the results is by no means unambiguous. Do the higher earnings of trained employees reflect their prior education, the training they have received on the job, or their innate ability (of which their educational achievement was merely a sign)?

First, Employers Already Invest Heavily in Training Their Employees

Most employees receive some form of training from their employers when they begin a new job, and most receive further training from their employers as they move up career ladders. In 1976, three-quarters of employees under the age of 25 reported being engaged in job training for an average of over 3.2 hours a week of separate training and 9.5 hours of training while engaged in productive activity.[19] Twenty-nine percent of those aged 55 to 64 reported 1.3 hours a week of separate training and 2.6 hours of training while engaged in production (Table 2).

Among the Panel Study of Income Dynamics (PSID) respondents in 1976 and 1978, the length of job training declined with working age (but at a decreasing rate for each additional year

[19] The NLS sample asked people receiving training on the job to distinguish between training that was separate from the job, and that which involved productive activities.

of experience) and increased with level of education attained, and was lengthier for married men than single men, and in nonunion than in union jobs.[20]

Table 2

Age	Percent Engaged in Training	Their Weekly Hours: Separately	Their Weekly Hours: Jointly with Production
< 25	76	3.2	9.5
25-34	72	1.8	7.5
35-44	58	1.7	6.4
45-54	48	0.4	2.1
55-64	29	1.3	2.6
All	72	1.8	6.8

Source: G. Duncan and F. Stafford, "The Use of Time and Technology by Households in the United States," *Research on Labor Economics*, Vol.3, 1980.

Based on estimates of wage gains, the total cost of employer-sponsored training in 1985—including foregone wages by employees and foregone productivity by employers (in excess of that compensated by lower wages)—ranges between $175 billion to $210 billion (in 1985 dollars). This estimate assumes that costs are shared equally by employers and employees, an assumption supported by the fact that the increase in productivity as a result of training is about double the increase in wages received by employees.[21]

These estimates of employer-training investments compare with $157 billion in direct expenditures on primary and secondary education in 1985, $65 billion in higher education (excluding foregone incomes which would more than double this estimate), and $23 billion by government (including the Department of Defense but excluding the cost of earnings during training, which also would probably double the total cost).

Annual total gross investments (expenditures and indirect costs) in human capital, therefore, exceed $500 billion, which compares with gross private investment in public and private fixed capital of $605 billion and net investments of $205 billion. Employer-sponsored training may

[20] Based on a regression analysis in which the duration of training was the dependent variable, Mincer, 1988c, p. 3.

[21] Estimates of the productivity increases resulting from employer-provided training are made by J. Barron et al, 1989, and Blakemore and Hoffman, 1988.

account for about one-third of the nation's total investments in human capital—including both expenditures and foregone income.

Second, Estimates of the Overall Rate of Return from Employer-Sponsored Training Vary Widely

Estimated wage gains suggest a high rate of return to employer-sponsored training because training, on average, absorbs only about one-fifth of an employee's time. The returns, however, must be adjusted for the fact that human capital depreciates. The only available estimate of the rate of depreciation is by Lillard and Tan who calculated that the wage gain due to training depreciates in a straight line at about 10 percent a year—or at a compound rate of between 15 and 20 percent.[22]

The estimated rate of depreciation means that the half-life of the investment is no more than three years and that three-quarters of the present value of future wage gains are enjoyed in the first five years after completing training. Employers can therefore recapture much of the benefits of investments in their employees in a relatively short time.

Table 3

Data Set	Male Labor Force Group	Discounted Wage Gain	Rates of return with Depreciation rate of: 20%	15%
EOPP[1]	New Hires	7.5	4.0	10.5
PSID[2]	Trainees in 1976	6.7	6.4	13.0
NLS[3]	New Entrants	7.0	5.6	12.2
NLS[4]	Youth Cohort	12.0	18.4	25.6
CPS[5]	All	12.0	18.4	25.6
PSID[6]	New Hires	9.0	6.4	13.0

Source: Mincer, 1988c, Table 13. 1 from Barron et al.; 2 from Duncan and Stafford; 3 from Lynch; 4 derived from Lynch; 5 from Lillard and Tan; 6 from Duncan and Stafford.

[22] Lillard and Tan, 1986, Table 4.3.

Using different estimates of wage gains, and two depreciation rates, gives a wide range of estimates of the rate of return to employer provided training, from 4 percent to 25.6 percent (Table 3). Unfortunately, we cannot pick a single "most-reasonable" estimate from the wide range shown above, the result of the range of estimated income gains from different sources. We cannot conclude, therefore, that employers should be offered incentives to expand training.

These Estimates Suffer Several Shortcomings

From the point of view of comparing rates of return among different types of assets, these estimates suffer from several shortcomings.

They do not separate average and marginal rates of return; they show only the average rate of return enjoyed by people receiving company training. But these averages do not indicate the marginal rate of return, the value of expanding investments in training. Because "human capital" is subject to the same diminishing returns to scale that affect all factors of production, additional investments will earn rates of return below the average rates.

They do not measure the relative risks of different investments. It would be inappropriate, however, to compare the estimates reported above with the before-tax rates of return on Treasury bonds, for example. Training employees, unlike buying Treasury bonds, is a risky investment.[23] For example, employee productivity may not increase as much as anticipated for several reasons: Learning ability may have been overestimated; the effectiveness of the training process may have been misjudged; or skills may be rendered obsolete more quickly than predicted. Investors demand higher rates of return on risky investments—a risk premium—to compensate for these unforeseen outcomes. Unfortunately, the data bases from which the rates of return were estimated do not allow the risks-of-training investments to be estimated.

They do not measure after-tax returns. It is also not appropriate to compare rates of return among different assets if the tax code treats investments differently. Employer-sponsored training receives extensive benefits under the federal tax code and under most state tax codes. Most costs, for example, can be expensed when they are incurred, not depreciated over the life of the investment. "Expensing" employer-provided training investments is valuable—it subsidizes training

[23] Treasury Bonds embody interest rate risks because investors may misjudge their liquidity needs.

by about 33 percent relative to longer-term investments.[24] Expensing cannot be avoided because a large part of training costs is wages paid while employees learn and could not be separated from other wages (which are expensed) for tax purposes.[25]

The estimates do not measure the value of indirect subsidies. In addition, an estimated one-third of employer-trained workers are enrolled in external, postsecondary education or training institutions.[26] The fees employers pay for most of these trainees are often less than the full cost of the training. There are no data on the true costs of public programs (public agencies rarely include depreciation on public facilities, for example) to compare with the revenues received for customized training programs.

If a disproportionate share of the returns of an investment are nonpecuniary then rates may be driven below rates on other assets without indicating over investment. For example, if some of the skills learned on the job spill over and improve the trainee's quality of life, then people will be eager to enroll in education or training even though the financial returns are low.

The value of education and training appear very different in the 1980s than they appeared a decade earlier. In 1976, a careful analysis of the returns to education, titled *The Overeducated American*, concluded that there was stronger evidence for over-investment than under-investment.[27] Yet, since the early 1980s, the preponderance of the evidence indicates the reverse. Rates of return to education have risen rapidly.

POLICY IMPLICATIONS

1. Estimates of the costs of and the wage gains from training are not sufficiently precise to determine whether employers systematically underinvest or overinvest in training their employees.

2. In view of the importance of human capital investments to overall economic growth, data should be collected systematically to allow the analysis of the level and effectiveness of all types of human capital investments, at least comparable with economic data compiled on investments in plant and equipment.

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[24] Vaughan,1989.

[25] Ibid.

[26] Carnevale, 1983.

[27] Freedman, 1976.

Even though it may never be possible to determine whether employers over- or under-invest, developing a "human capital" data base that is collected regularly could provide a valuable insight into the process of economic development that is, at present, missing. For many years, monthly data on the rates of change and the levels of investments in physical capital—in aggregate, by industry, and by region—have been used to monitor and diagnose economic development and economic problems. No comparable data on investments in human capital have been developed and used. The data used in the studies described above are old, and, at present, there are no data collected regularly on employer-sponsored training.

National human capital investment data should be collected regularly. The data should include longitudinal panel-data so that career patterns of training, earnings, and other aspects of labor market behavior can be measured. In addition, employer surveys are needed to assess the determinants of training investments, by firm size, by type of activity, and by other industry characteristics.

Regular reports should be issued showing changes in the rates of investment so that they can be included in economic indicators to balance the economic picture presented by changes in physical capital investments. The data would be of value not only to economists but also to those concerned with education policy.

QUESTION 3: HOW WILL THE PACE OF TECHNOLOGICAL CHANGE AFFECT THE NEED FOR EMPLOYER TRAINING?

Rapid technological change in an industry increases the probability of getting managerial training and training from in-house sources . . . especially for the most educated, but decreases the probability of getting professional, technical and semi-skilled manual training, or training from external sources such as business, technical and traditional schools . . . possibly because skills specific to new technologies are not readily available outside the firm.

Lee Lillard and Hong Tan, 1986

THE POLICY ISSUE

How will employers' demands for educated labor change if the pace of new products and new production technologies is sustained or accelerates?

Although the role of the federal government in education and training is limited, the roles of state and local governments in financing and managing education and training programs are extensive. Yet public training and education programs cannot be expanded or redesigned quickly because the state and local budget-making process is not flexible. They can adapt, however, if managers recognize that the need for skilled employees is changing, if current education programs have proved successful and are well-used by employers, and if local fiscal conditions permit. Anticipating how employers' demands are changing can help state and local agencies decide faster what needs to be done and how to do it.

Because the success of human capital investments strategy depends on coordination among employers and educational institutions, anticipating the changing demands for human capital can help these links between public and private agencies to adapt more effectively.

THE EVIDENCE

Adapting to new technologies demands better educated people.

As they adapt to technological change, employers will demand employees with broader skills and deeper educational attainments. Many of these employees will be trained more intensively and more frequently on the job.

Industries in which productivity is growing fast, in which the capital stock is newer and in which research and development expenditures as a percent of sales are relatively high hire

better-educated workers.[28] In the short run, the onset of high productivity growth in a sector increases outside training relative to on-the-job training.[29] In the long run, it leads to greater in-house training and less outside training. These results allow for the fact that new hires in industries where employment is growing will tend to be better educated than the workforce as a whole because each new workforce cohort is better educated.

Better-educated new entrants are more likely to choose jobs in high productivity growth industries and better educated workers are attracted from other sectors and even from other firms in the sector. Wage trajectories steepen. And, after a lag, companies begin to invest more heavily in training.

Rapid technological change renders skills obsolete faster

Although total investments in on the job training increase as the rate of technological change increases, those investments become obsolete faster. Employers, therefore, invest less in each episode of training, but retrain employees more often.[30] Because it is more difficult, and perhaps less valuable, to retrain older workers, early retirement in Japan is used more frequently in industries where technology is changing more rapidly.[31]

Japanese employers about whom data are available invest much more heavily than United States employers in training their employees. This is true even of Japanese firms managing branch plants in the United States. This emphasis on training has been credited with the rapid Japanese growth in productivity. Japanese employers train 24.4 percent of their new workers at a cost of $1,000 per new hire while U.S. employers train only 13.5 percent of new hires at a cost of only $215 each.

The popular view of Japanese industrial relations stresses the importance of cultural characteristics of employees—greater discipline and loyalty, for example—in explaining lower labor force turnover. Japanese firms reward tenure more heavily than do U.S. firms. Mincer and Higuchi found that turnover and wage-tenure relationships in Japanese-managed plants in the U.S.

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[28] Mincer, 1988c, and Bartel and Lichtenberg, 1987 and Gill, 1988.

[29] See Lillard and Tan, 1986, and Tan, 1987.

[30] Mincer and Higuchi, 1988.

[31] Ibid.

are much closer to Japanese than to U.S. averages. But as much as 70 or 80 percent of the Japanese/American differences may be due to differences in the rate at which technology is raising productivity.

It would be misleading to attribute Japanese economic success to their greater investments in employer training. Only about 11 percent of the new entrants to the Japanese workforce have graduated from postsecondary education and training programs, compared with 32 percent in the U.S. If on-the-job training is a partial substitute for formal education, Japanese employers have been forced to invest more heavily to compensate.[32]

Industries where technology is changing rapidly pay employees more

Wages send clear signals of the shifting demands and availability of human capital in the face of technological change. Initially, accelerating productivity growth *reduces* wages in the growth sector relative to other sectors, reflecting labor-saving changes and the obsolescence of the skills of current employees. But the rate of return to education *increases*, raising wages of educated workers relative to wages of less-educated workers.

Industries employing new technologies pay employees of all educational attainments better than industries employing traditional technologies.[33] Bartel and Lichtenberg argue that this reflects their greater ability to operate effectively in the less-structured work environment caused by the purchase of new equipment and the greater difficulty of monitoring employee-performance after the adoption of new technologies.

Technological change does not create long-term unemployment

Despite the traditional fear that technology that increases productivity leads to unemployment, it appears that, in our increasingly competitive international economy, workers are most likely to become unemployed and to remain unemployed in those industries where productivity growth is not growing.

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[32] Mincer and Higuchi, Op. Cit.

[33] Bartel and Lichtenberg, 1987.

POLICY IMPLICATIONS

1. Employers' demands for well-educated and trained employees will grow as the pace quickens with which new technologies are adopted. Without a supply of well-educated employees, employers' ability to benefit from new technologies may be slowed and the nation's comparative advantage in skill intensive activities diminished.

2. The growing premium earned by well-educated employees, and the complementarity of education will make it more and more difficult for disadvantaged people to escape from poverty unless their lack of skills can be overcome.

Although policymakers have feared that new technologies will lead to a shortage of jobs, their impact has been to increase the rewards to education. If the pace of technological change is sustained in the future, the major policy concern will be equipping people for new jobs, not finding them work.

Improving the overall educational attainment of the workforce will be the only way in which employers' growing needs for trainable employees can be met. Adapting to new technology is not a problem that employers can easily solve in the workplace. To train people for new skills they will need people with broader and deeper competencies. If they must train their employees in more and more advanced occupational skills, they will be less and less able to use mediocre high school graduates and less and less able to provide any remedial education or training in the workplace. The challenge of learning to live with new technologies and extracting their full potential to raise productivity must be met, in large part, in primary and secondary schools.

The education system must not only raise average levels of educational attainment, it must sharply reduce the share of high school and postsecondary program graduates with poor qualifications. With a shrinking share of new jobs open to poorly qualified people, and the overall rate of growth of the workforce falling, the nation's education system must dramatically reduce the "reject rate". In an economy evolving, increasingly, into an educational meritocracy in which most earnings are returns to human capital, the cost of failing to prepare so many people for productive employment is demanding greater attention to at-risk students.

AFTERWORD

For fifty years, since the beginning of the Great Depression, the primary concern of economic policy has been jobs. Many policymakers have forgotten that, before 1930, economic development in most U.S. communities had suffered from persistent shortages of labor that had generated pressure to expand public education, open immigration, and develop labor-saving technologies.

Today, the U.S. again faces a labor shortage. But it is a shortage of skilled workers. It will be less easy to import what we need from foreign countries, although the pressure to do so may lead to tension with trading partners. This shortage has again directed policymakers to the need to improve public education and to relax restrictions on immigration.

APPENDIX: DATA SOURCES

Analyzing employer training investments and their effects on productivity and labor market success uses the histories of many thousands of people, how their earnings change over time, how their success in finding work, and their employment stability are related to their family backgrounds, education, prior training, training by employers, and tenure on the job.

Unfortunately, we cannot use a single data base collected at regular intervals. Instead, we have had to rely on several different, and noncompatible, sources of data. Each defines employer-sponsored training differently, has sampled different groups of employees, and has been collected at different times:[34]

Panel Study of Income Dynamics (PSID). Data on 1,200 male heads of households (excluding students and self-employed) reinterviewed regularly between 1968 and 1983, includes wage, education, training, and work experience. Direct information on job training is provided in the surveys of 1976 and 1978, including the answers to the question: "On a job like yours, how long would it take the average new person to become fully-trained and qualified?"

National Longitudinal Surveys (NLS). Cohorts of young (14 to 24) and mature (45 to 59) men were sampled between 1966 and 1981, and young (30 to 44) women were sampled in 1967. The survey asks the most detailed questions concerning the types and sources of training received by participants in their longest training event since the respondents' last interview (a period that varied between 1 and 5 years).

Current Population Survey. A nationally representative sample of the population is surveyed several times a year and forms the basis of unemployment rate and income estimates. In January 1983, CPA was supplemented with questions on occupational mobility, job tenure, and training. This supplement asked what training was needed for the respondent to get their current job and what training was needed to improve skills "since you obtained your present job."

Employment Opportunities Pilot Projects Survey (EOPP). These surveys were undertaken between May and September 1980, designed to evaluate how participation in job-search and work-and-training programs influenced the labor market experience of economically disadvantaged

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[34] These data sources are discussed in greater detail in Lillard and Tan, 1986.

people since January 1979. Lillard and Tan summarize the information provided on sources and types of training from these different surveys in Table 2.2, p.9:

Survey	Sources of Training
NLS CPS EOPP	Company schools or courses
NLS EOPP	Business, technical, and vocational schools
NLS CPS	Traditional schools, colleges, universities
CPS	Current job; informal OJT
NLS	Other sources (e.g., Manpower Development and Training Act)
CPS	Other sources such as armed forces

Survey	Type of Training
NLS	Managerial
NLS	Professional and technical
NLS	Clerical (women only)
NLS	Manual, skilled and semi-skilled
NLS	Other (including general courses)

These data suffer from several weaknesses: first, the definition of training is often based on the respondents' subjective definition of training; second, many of the individual career profiles began in the 1960s and 1970s and may not correspond to the labor market today when the number of new entrants has fallen dramatically and technology is demanding higher skill levels; and third, the surveys provide little information on the costs of training.

Industries adopting new technologies were identified by using the total factor productivity indices computed by Conrad and Jorgenson—a measure of the consequences of technological change.[35] This includes detailed adjustments for changing age, education, and sex composition of the workforce. The productivity growth residuals are, therefore, purged of human capital components.

[35] Conrad and Jorgenson, 1985.

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